Research Product 2010-02

Achieving Adaptability through Inquiry Based Learning

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April 2010

ARI – Fort Benning Research Unit

United States Army Research Institute
for the Behavioral and Social Sciences

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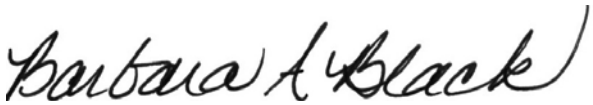

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REPORT DOCUMENTATION PAGE

1. REPORT DATE (dd-mm-yy)	2. REPORT TYPE	3. DATES COVERED (from. . . to)
June 2010	Final	September 2009 - February 2010

4. TITLE AND SUBTITLE	5a. CONTRACT OR GRANT NUMBER
Achieving Adaptability through Inquiry Based Learning	
	5b. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)	5c. PROJECT NUMBER
Thomas M. Duffy (Indiana University) and Pamela Raymer (Army Management Staff College)	633007A792
	5d. TASK NUMBER 360
	5e. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)	8. PERFORMING ORGANIZATION REPORT NUMBER
School of Education Indiana University 201 North Rose Bloomington, IN 47405 Army Management Staff College 5500 21st Street Ft. Belvoir, VA 22060	

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. MONITOR ACRONYM
U.S. Army Research Institute for the Behavioral and Social Sciences 2511 Jefferson Davis Highway Arlington, VA 22202-3926 Source Code: 597861	ARI
	11. MONITOR REPORT NUMBER Research Product 2010-02

12. DISTRIBUTION/AVAILABILITY STATEMENT

Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES

Subject Matter POC: Dr. William Bickley (ARI-Fort Benning)

14. ABSTRACT *(Maximum 200 words)*:

This report presents inquiry based learning (IBL) as an instructional strategy addressing the Army's need for training flexible and adaptive leaders. Distinguishing tenets of IBL are characterized in contrast to the Army's current direct instruction strategy. Elements of IBL, including characterization of the orienting problem, learner support by the instructor, and assessment of learner outcomes are outlined. Considerations for developing an IBL curriculum are addressed, and details of an example of an Army IBL course of instruction are provided.

15. SUBJECT TERMS

Inquiry based learning, problem based learning, Army training, adaptability, constructivism, instructional methods

SECURITY CLASSIFICATION OF			19. LIMITATION OF ABSTRACT	20. NUMBER OF PAGES	21. RESPONSIBLE PERSON
16. REPORT	17. ABSTRACT	18. THIS PAGE			
Unclassified	Unclassified	Unclassified	Unlimited	33	Ellen Kinzer Technical Publications Specialist 703-602-8049

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June 2010

Army Project Number
633007A792

Personnel Performance and Training

ACKNOWLEDGEMENT

We would like to thank Bob Bauer, Steve Frieman, Rick Milter, and John Stinson for their comments on earlier versions of this report. Their input certainly led to a better final product.

ACHIEVING ADAPTABILITY THROUGH INQUIRY BASED LEARNING

EXECUTIVE SUMMARY

Research Requirement:

The Office of the Under Secretary of Defense (Readiness) (2007) and the Department of the Army (2006a, b) have both identified the need to develop military and civilian leaders who are flexible and who can successfully adapt to rapidly changing conditions in the Contemporary Operating Environment. The need to develop these leaders has given the Army the impetus to investigate learning strategies and models of higher level cognitive processing for their effectiveness in Soldiers' learning to perform adaptively. Inquiry based learning (IBL) is one such strategy. This paper elaborates on IBL and discusses how it may be implemented in the Army training environment.

Procedure:

The paper characterizes IBL as an instructional strategy that is centered around problem solving, with the learners taking personal ownership of and responsibility for solving the problem. The paper points out that by learners taking personal ownership of the problem, the role of the instructor changes from one of directing learners to one of supporting learners – if learners own and are responsible for a problem, then they are responsible for finding the problem solution. The instructor's role becomes one of helping them refine their thinking as the learners attain their solution

Drawing on the characterization of IBL the paper then gives a rationale for how IBL is a viable candidate for providing instruction and experience in adaptability. With IBL, learners gain experience in making sense of a problem. As they develop the solution to a problem, the problem begins to make sense, and learners begin to problem solve and adapt.

The latter part of the paper outlines the necessary components of IBL and how they can be combined into a course of instruction, and then presents as an example the outline of a current Army IBL-based course.

Findings:

The paper shows IBL as an instructional strategy that addresses the Army's need to foster adaptability, and also presents an example of Army IBL-based instruction.

Utilization and Dissemination of Findings:

The results serve as a characterization and a baseline example of the IBL model for use by Army training developers, training designers, and instructors

ACHIEVING ADAPTABILITY THROUGH INQUIRY BASED LEARNING

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Achieving Adaptability through Inquiry Based Learning

Background

The purpose of this paper is to provide guidance on the use of inquiry based learning (IBL) instructional strategies and to outline how use of IBL strategies can foster Soldier adaptability which is defined as the ability to respond decisively and confidently in ambiguous situations. Specifically, we will identify the key features of IBL and discuss why these features are important to learning and why they contribute to adaptability. We will then more broadly describe the ways in which IBL may be implemented. Finally, we will discuss the strategies for analyzing, designing, and developing an IBL course.

For the Army, the need for this type of learning strategy is evidenced by a number of studies. A 2006 report, "The Review of Education, Training and Assignments for Leaders (RETAL)," identified these military and civilian leader attributes: "a strategic and creative thinker; a builder of leaders and teams; a competent full-spectrum war fighter or professional who supports the Soldier; one who is effective in managing, leading and changing large organizations; one skilled in governance, statesmanship and diplomacy and one who understands cultural context and works effectively across it" (Dept. of the Army, 2006a, b). The Office of the Deputy Under Secretary of Defense (Readiness) commissioned a 2005 study on training. The report concluded that a new skill set characterized as adaptability was needed to respond to the unpredictable nature of the asymmetric threat in the Contemporary Operating Environment. In preparing for an Adaptability Symposium to address these shortfalls in July 2007, OSD cited the need for all of the military services to "enhance their learning paradigm to facilitate adaptability learning for individuals and units at every stage of a career and at every level of organization" (Office of the Under Secretary of Defense, 2007).

The 2008 "Joint Operating Environment" study states that the critical key for the joint force of the future is the preparation of the senior leaders. The study concludes that: "All military leaders must be equipped with the confidence to decide and act in ambiguous situations and under conditions when clear direction from above may be lacking or overcome by changing conditions." (U.S. Joint Forces Command, 2008, p. 49) In addition the study specifically cites critical and creative thinking, agility and adaptability as necessary intellectual skills needed to meet the challenges that will face the future joint force.

Inquiry Based Learning (IBL) curriculum approaches address this increased requirement for flexibility and adaptability at all levels. We use the term Inquiry Based Learning to encompass a variety of instructional methods, all of which center around learning through the inquiry process or, more generally, learning by doing. Dewey (1910), a progressive educator in early 20th century, believed that the learning process begins when the learner is placed in a state of "perplexity, confusion or doubt" (p 12). To overcome this state, the learner searches for solutions by engaging in inquiry and reflective thinking. He said that thinking does not happen spontaneously – something

triggers this activity. Placing the learner in IBL activities can be that triggering activity. The approaches that tend to fit this framework include problem based learning (Barrows, 1986, 1992; Savery and Duffy, 1995), project based learning (Blumenfeld, Soloway, Marx, et al., 1991), learning by design (Hmelo, Holden, & Kolodner, 2000; Kolodner, Camp, Crismond, et.al., 2003) and learning through invention (Schwartz and Martin, 2009).

Key Characteristics of IBL

IBL approaches have become increasingly popular in the school systems (Edelson, Gordin & Pea, 1999) as well as in corporate training (Kramer, 2008) and with that popularity have come many misconceptions about the approach. This section begins by directly addressing these misconceptions. After an explanation of what IBL is not, discussion turns to the critical characteristics of any IBL approach, an approach that supports adaptability in learners.

What IBL is <u>Not</u>

IBL, as reflected in the variety of its instructional approaches, often comes under criticism for not being rigorous enough in the learning demands placed on learners. More specifically, there are four primary criticisms that cite lack of rigor:

First, some claim that the IBL approaches simply throw the students into the problem and let them sink or swim. While this is a common belief (see, e.g., Kirschner, Sweller, & Clark, 2006; Tobias and Duffy, 2009), in fact the guidance provided to learners is a critical part of any IBL method. However, the guidance is focused on promoting the students' critical thinking rather than taking away the need to think by simply telling them what to do or what to pay attention to. This is a critical distinction returned to throughout this paper.

Second, others have claimed that in IBL any solution set provided by the student is acceptable simply because it was based on the student's analysis. This is a view that has likely arisen from the behaviorist tradition where it is argued that one must reinforce rather than critique students (Foshay, Silber, Stelnicki, 2003). As a consequence, one finds that there is a tendency for some instructors trying to implement an IBL approach to either not ask students for their analysis of a problem (except on an exam) or, if students do provide their analysis, treat it as an opinion not to be challenged (it is analogous to asking someone to name a favorite movie – no defense is needed since it is an opinion). Indeed, in the undergraduate education program at Indiana University, it is often the case that students like to hear the opinions of many other students so they can choose the one they like the best –there is no notion of critical analysis or dialectic interchange (Osman, Duffy, Chang, & Lee, 2007) However, challenging the learner's thinking is at the heart of the IBL process (Zhang, 2009); understanding is seen as growing through serious discussion of alternative perspectives. While the students own the decision, plan, or action produced as part of the IBL learning process, they must also be prepared to defend

their work through rigorous discussion of the information that informed their position and their consideration of alternatives.

The challenge to the students' thinking also encourages them to critically evaluate their sources of information. A basic tenet for Dewey (1910) is that inquiry is problematic because it requires the learner to overcome the inertia associated with the tendency to accept the opinions of others especially when the opinion comes from an expert. Critically evaluating information serves to deepen and enrich the learner's thinking skills and ultimately learning. Dewey adds that as learners continue their inquiry, they must delay reaching conclusions and be willing to maintain a prolonged state of doubt to generate the best solutions. That doubt must be maintained as the individual continues to evaluate the situation until a decision is required. This is consistent with Suchman's (1987) argument that plans are a starting place but are constantly adapted based on context. As the learner cycles through this iterative process, the learner's problem-solving capability improves because of the additional practice and the need to become more efficient in problem-solving when less time is available.

A third misconception about IBL is that there is no direct instruction. The belief often heard expressed is that the students must discover everything on their own (Klahr, 2009). However, lectures and demonstrations are very often an important part of the learning environment. In contrast to traditional classroom instruction, however, the lectures and demonstrations are provided after the learner has already wrestled with the issue. That is, they have worked on the issue and they now recognize a need for learning (Duffy, Stinson, Milter, & Kirkley, 2008; Milter & Stinson, 1995) . This is no different than what we find in our own everyday learning. We go to conferences and workshops based on the work we are doing – we have a problem we are trying to resolve and we go not to learn the lecture or presentation but rather to use the lecture as a source of information to apply to our problem analysis and problem solving.

Finally, it is often argued that IBL is good for higher level, more complex problem solving, but it is not adequate for training the technical skills like those learned in military and technical training. For example, the argument is that IBL may be effective for military tasks like negotiating with a tribal leader, conducting a patrol or operating a checkpoint. However, the argument continues, well defined procedural skills such as repairing an engine, changing a tank track, or loading a mortar are best taught through direct instruction. But if one considers what the goals of the instruction should be, it is clear that these procedural tasks should not be performed as an end-state but rather as the means to achieving a real world-task or solving a real problem. Well-structured tasks such as these are more efficiently taught using a behavioral approach – – although problem-solving requirements can be built into behavioral approaches for tasks such as these – but teaching them in isolation from the ill-structured tasks that they support is not appropriate. Repairing an engine, replacing a tank track or loading a mortar is not the end-state. The end-state is adapting these skills in performing missions required in Full Spectrum Operations (FSO) where proficiency in well-structured tasks facilitates adaptation of that procedure as necessary to support the larger goal.

The question becomes, how should instruction be organized to support the larger outcome; where does the procedural task fit in the larger instructional sequence? Consider, for example, one of the tasks of an Army fire direction officer (FDO): the ability to perform fire planning in support of the maneuver commander on the battlefield. Traditional instruction typically uses classroom instruction to teach the Field Artillery Lieutenant how to complete a Target List Worksheet identifying the planned targets and how to complete a Target Execution Matrix identifying the order of the firing. The focus is on teaching the technical tasks and not the critical thinking skills associated with fire planning in the field. Weeks later, when the students are required to use these technical skills in a simulated field problem, they have difficulty completing the tasks because the technical skills were taught in isolation and are rigidly followed rather than adapted to the particular context. Even though it is in the field exercise that students typically report learning the most, because it occurs at the end of the course, they have little if any opportunity to learn to adapt the procedures and, indeed, unlearn some of the rigid procedures learned in the classroom (Raymer, 2006a; Spiro, Feltovitch, Jacobson, & Coulson, 1992)

As one observes teachers and instructors who purport to use an IBL approach, frequently these four misconceptions are reflected in the instruction. They do not develop structures to support and guide student learning, they do not challenge student thinking, and they do not share their expertise at any time during the learning experience. These are not effective applications of IBL and, in fact, totally unstructured and unguided learning may well be less effective than the very structured direct instruction. (Tobias and Duffy, 2009)

These problems arise, at least in part, from a lack of understanding of the learning model underlying IBL. The majority of instructors grew up under a traditional teaching approach based on behaviorism and information processing. In essence, the belief is that knowledge can be transferred to the individual by using the appropriate presentation and reinforcement strategies. Once the knowledge is transferred to the head of the learners, they will be able to use/apply that knowledge. IBL is based on a different conception of learning, one traceable back to John Dewey (1910) and Jean Piaget (1972; von Glasersfeld, 1995) and which emphasizes the importance of the goals and needs of the learners as important determinants of what is learned in any situation (in the school house or in the field) including the development of a learner who is an adaptable job performer. This will be discussed in more detail later, but having focused on what IBL is not, focus now turns to the key characteristics of an IBL approach.

Critical Characteristics of IBL

There are three critical characteristics of an IBL learning environment – characteristics that apply regardless of the particular IBL instructional methodology.

Learning is centered around problem solving. All learning is centered around problem solving. That is, learning begins with a problem and all of the learner's activities are centered on the goal of resolving that problem such that the resolution can

be explained and defended against alternatives. Traditional instruction typically has students learn individual concepts and procedures, integrating them at the end of instruction through a complex integrative problem. IBL can be thought of as reversing that process. Instruction begins with the more complex, integrative problem and then learning of the individual concepts and procedures occurs within the context of that problem; the problem provides an organizational structure or schema for integrating understanding. Research shows that institutional/school learning that occurs in context is richer and deeper and transfers more easily to the work environment (Foshay, et al,. 2003; Noe, 2008; Bereiter, 2002). The result is a richer understanding of the relationship and contextual limitation of the concepts and procedures thus leading to greater adaptability in authentic contexts.

It must be emphasized that IBL does not just start instruction with a problem, but rather all learning centers around the learner's work in developing a response to that problem. This view coincides with Dewey's (1910) argument that inquiry is not spontaneous – it originates with some need. This is in contrast to many traditional instructional approaches that use a problem at the start of instruction simply to motivate the learners, showing them that what is being learned is important and will apply. In the traditional approach, these problems may be examples from the field, (e.g., battle scenarios or problems in negotiating with tribal leaders), clips from movies that will motivate students (e.g., a clip from *Saving Private Ryan)* or classroom games to illustrate an abstract principle (e.g., using games to illustrate the various sort of communication paths and the effects on performance). But in all of these cases, the problems are used to illustrate and motivate. In this traditional approach, instruction then proceeds with some sequence of lecture (demonstration), practice, and test for each of the concepts, techniques and procedures; later these are practiced in the context of the whole. In essence, the traditional approach, in contrast to IBL, goes from part to whole learning – learning the individual parts in isolation and then putting them together after they are learned.

The learner takes ownership of the problem. The goals of the learner determine what is learned (Dewey, 1910; Duffy 2009; Piaget, 1972; Schank, Fano, Bell, and Jona, 1993). If the learners are focused on figuring out what the instructor wants, then they will not be focused on thinking about the issues in the domain. It is much like studying to pass a test. In the test preparation approach, the learners are focused on what is emphasized and what they expect to be on the test. The learning is integrated around answering test questions.

In contrast, if learners take ownership of the problem, treat it as one that needs to be addressed and are willing to wrestle with the complexities of the problem, then they will use the text and lectures to identify information relevant to that problem solving. That is, they embed themselves into the issues of the domain rather than the issues of testing. As a consequence, the concepts, techniques, and procedures are integrated in their thinking around the issues of the domain. This is critical to transfer of learning. That is, the problems used in inquiry are representative of the problems and tasks they will encounter in the work place. Thus, the concepts and procedures are contextualized in

these reasonably authentic contexts. Further, questioning as to how their response will change under changing conditions will further enhance that transfer.

Learning is supported rather than directed. Central to the IBL approaches is the view that the learners must know what they do not know. Imagine reading instructions for assembling something complex and then putting the instructions aside and beginning the assembly process. Of course as soon as one begins work, one discovers what is not known and perhaps what was misinterpreted. Trying something first gives a perspective on one's knowledge and skill needs.

But it is not just knowing what they do not know in a general sense. It is not just saying, "I need to know how to lead a platoon." Rather, it is getting down into the details. It involves developing a personal perspective on specifically what you must do and know and also why you need to know and do it. That is, learners need to formulate a point of view or perspective at least partially filled in; they must have their own perspective to use in evaluating and integrating what they are being taught.

If they developed their own solution to a problem without instruction, it is almost certain to be incomplete and even likely to be wrong. However, they have now struggled with the problem, identified what they consider to be the relevant concepts and procedures, and developed a point of view. Now they are ready to learn – they have a perspective from which to evaluate relevance and adjust their view. This is much as we do in our professional life when we go to lectures or read a book relevant to the problem we are working on. That lecture or book takes on rich meaning because we recognize the need to know and, just as importantly, we have a point of view we can use to evaluate and integrate the information.

One way to think about this is in terms of the learners doing the practical exercise (PE) before receiving instruction. It is not important that they get the PE right – in fact, they likely will not get it right. What is important is that the PE forces them to think about the issues and take a position. Now they have their own framework for learning from lecture, demonstration, or text that might be used as part of the learning activities. Here the learner is using the lectures and other information to help them in their work on the problem: there are specific learning needs. This contrasts to traditional instruction where they are not engaged in problem solving and hence do not have specific problems driving their learning.

These opportunities to use errors to recognize the need for learning and to establish a framework for the learning cannot be open-ended exercises that will place the learner at risk. Certainly safety precautions must be in place for potentially dangerous activities. The instruction follows the exercise and following this instruction the learners are ready to incorporate what they learned in their continued analysis of the problem or to apply that learning to another PE.

It is important to recognize that errors or the inability to fully make sense of a situation provides the basis for learning (Piaget, 1973; Schank, et al, 1993). Thus the errors are corrected in the learning process. When time is constrained, learning activities must be structured to ensure that learners do not end the activity without sufficient time to engage in the necessary learning to assure successful transfer to new situations. This may be achieved by narrowing the focus of the training to critical issues. Unfortunately, too often the opposite decision is made: "covering" the content at a more surface level. If our goal is to support the Soldiers in being able to "do" the job, then this superficial coverage is simply not adequate.

Rationale for IBL

Why are these three factors considered as the critical characteristics of IBL? Simply put, it is based on our framework for thinking about how people learn. The framework is quite basic and should feel very familiar to many people's learning experiences outside of school, i.e., in the real world. Basically, the argument is that learning is a process of sense making: we learn when we need to make sense of some aspect of our world. Usually we can navigate our world with no surprises. We have expectations and they are met – or easily interpreted. However, when a person cannot make sense of the world and it is important to do so, the person engages in learning. The sense making may be driven by a functional need (e.g., learning to use maps to navigate; learning to drive a car) or because of interest or wonder (learning to play chess or golf or identify birds), or simply because it is something that is not understood but is relevant to accomplishing the mission (e.g., understanding the effect of combat stress on Soldiers.)

Learning activities are centered on understanding in order to make sense of the situation based on goals and being able to do the task. So the sense-making goal directs the focus of learning efforts in listening to a lecture, watching a demonstration, or using text, technology, or people resources. A course instructor reading a book or attending a lecture on leadership will be attending to different things – learning different things – than a platoon leader about to deploy. Each one will focus attention on different issues, interpret concepts, techniques, and procedures in different ways, and organize understanding in different ways.

Perhaps the effect is most dramatic in the American (or any) school system. The sense making in schools is generally set around passing tests in order to pass the course. So, typically students are not thinking of the subject matter domain and grappling with the issues – building their schema of chemistry or historical analysis, etc. Rather they are focused on identifying what will be on the test. They are looking at what is underlined or highlighted in the book, what the teacher writes on the board or emphasizes, how they can get the teacher to tell them what is important, etc. There is little attempt to develop an understanding of the subject matter outside of passing a test, the sense making is focused on the test, not the domain. Alfred North Whitehead (1929) referred to this school focused sense making as developing inert knowledge, i.e., knowledge used in school but not applied outside of school. Consistent with this view, a common complaint

from employers hiring college students that they come with good grades but can't do very much in the workplace, or in the case of a company commander, that platoon leaders after graduation may be technically proficient but are not ready to lead, to make difficult decisions. It would appear that a primary factor in this is that what they are learning is not properly contextualized and is not designed to maximize acquisition of functional or useable knowledge.

Pervasive Learning Outcomes

Any IBL environment will focus on domain specific learning: the concepts, skills, and procedures relevant to the content domain. However, there are also learning outcomes that are a part of IBL regardless of the specific instructional approach. These pervasive outcomes include initiative, confidence, and problem solving skills.. In all IBL instruction the learners must take the lead and so certainly initiative is central. Further, confidence is promoted not just through ownership of the problem but also by their ability to explain and defend their position on the problem. Finally, the entire IBL approach centers around problem solving.

These three characteristics — initiative, confidence, and problem solving — have been emphasized as important characteristics for all Soldiers to possess in FSO. FSO, with its complexities of fighting against a hybrid threat, requires decision-making and problem solving at lower levels of authority than previously experienced. On a much broader scale and scope than before, Soldiers are expected to interpret the commander's intent in the context of the immediate situation (U.S. Department of the Army, 2008). That is, they are expected to be adaptable and agile in their assessment of situations.

The need to address agility as reflected in problem solving skills, confidence and initiative has also been discussed under the framework of Outcomes Based Education and Training (OBTE). The OBTE framework emphasizes that outcomes must take into account not only the formal learning outcomes for which lesson plans and training sessions are designed but also the outcomes that arise informally through the instructor or trainer's interaction with the Soldier and the overall curriculum design. Thus any interaction with the Soldier is seen to have an effect on that Soldier, either increasing or decreasing the Soldier's confidence, initiative, and tendency to engage in problem solving (Riccio, Dietrich, & Cortes, 2009).

The IBL approach specifies these agility objectives as part of formal training and education. They are a natural part of the IBL instructional approach when properly executed and should be articulated in the outcomes for the IBL instruction. Thus while OBTE emphasizes the more micro instructor-student interaction, IBL emphasizes the instructional design and formal assessment of all learning outcomes. Indeed, the instructor-student interactions as described in the OBTE literature are essential to the successful execution of IBL instruction. In turn, the IBL instructional approach facilitates the ability of instructors to promote the agile thinking and performance of the Soldier by including these overarching competencies so needed for the Soldier in FSO. Thus there

is a strong symbiotic relation between OBTE and IBL; together they emphasize the importance of both the design of the training environments and the preparation of instructors.

The Components of the IBL Approaches

This section addresses the more practical issues of IBL, the components in an IBL course. Since the term IBL is used to identify a family of instructional approaches, there is much variation in how these components are incorporated. Some of these variations will be discussed, but this is not a procedural guide: the designer must think about these components in the context of the key characteristics of IBL and the "sense-making" view of learning. The Appendix provides an example of the application of an IBL design reflecting a problem centered learning approach in the advanced Army civilian leadership education program.

The Problem

If learning is a matter of sense making, then it must be certain that the problems given Soldiers to work on in training — the problems that drive the course experience — involve them in learning and using the targeted concepts, techniques, and procedures in a way that will prepare them to lead in the complex COE. The problem should have the following five characteristics.

First, the problem should be complex, calling for analysis and judgment. It is not an isolated skill, strategy, or concept being learned, but rather it is the ability to analyze a complex situation in the COE that has offensive, defensive, and civil support considerations. That complexity will almost always allow for different points of view depending on the background of the Soldier, what is emphasized in the analysis, and what assumptions are made. Problems of this sort are reflected in many of the hybrid threats that challenge Soldiers and require constant assessment, judgment, and decision-making.

As should be clear from earlier discussion, the fact that a problem is complex does not mean just any decision is acceptable. Clearly, in real life situations there are bad decisions, decisions that are not rationally justified. However, there are likely to be several alternative correct decisions, decisions based on a strong analysis of the information available.

Second, the problem presented to the learners should have three components: establishing the context, identifying the particular task or problem that needs to be addressed, and specifying in some detail what the learners are to produce in the end and who will be reviewing it. Regarding the product, learners will often focus on the format and media more than the content. Focus should not be on slick PowerPoint® slides — informal professional presentations are generally best. Also learners must be prepared to defend their analysis and conclusions based on data and should be ready to evaluate alternative Courses of Action (COAs) that might be suggested. Clarity as to requirements is essential.

Third, the problem must be *authentic*. It must represent the kinds of situations the Soldiers will face in the COE and call on the application of the critical technical skills and cognitive strategies required in that situation. Of course the problem often cannot be the real situation the Soldiers will face: equipment costs and access, potential danger, and simply the authenticity of the experience limit what we can do. The problem and context need not replicate the situation; rather, the goal is to create realistic situations, with realistic demands as well as constraints on the cognitive and skill requirements.

Fourth, the problem must be designed to engage the learners in the key concepts, techniques, and procedures that they must be able to apply in the field. That is, it is not just an authentic problem but it is an authentic problem that will lead to the learning objectives necessary to prepare the Soldiers for the real world problem. Designing a series of problems that are not just authentic and motivating but also lead to the intended learning objectives is a demanding instructional design process. This is especially true since several or many learning outcomes must be achieved through work on a given problem. The next section of this paper discusses the strategy for identifying outcomes and relating them to problems.

Finally, the problems must be presented to the learners in a way that engages them in it as a real problem rather than an academic exercise. The introduction of the problem must move the Soldiers beyond the traditional training/learning attitude of "what does the instructor want" or passing a test or simply achieving proficiency in isolated technical tasks. It is from the authentic problem-centered focus of the learners that they will learn in a way that will transfer to FSO – exhibiting initiative, confidence and problem-solving..

Beyond these five considerations, there is considerable flexibility in the use of problems. Problems may be at any level of complexity and address any number of learning outcomes or objectives. The enabling objectives, as described in traditional instruction, are an implicit component of the learning since they are embedded in the context and must be understood in order to address the problem and the primary learning outcomes that are explicitly part of the problem. The problem may occur in the field as in training exercises or in the classroom. The time allowed for work on the problem is also very flexible, though generally a problem should last at least a full education or training day and preferably 3 or more days. The reason for this is that problems with a short timeline generally fail to engage the students in the problem – they are pressed for time and hence focus on what they need to produce (meeting the instructor's requirements) rather than the learning process. Additionally problems of shorter duration in a learning environment do not generally enable the complexity so necessary for acquiring the skills and strategies that IBL calls for.

One interesting point to consider is that the same problem may be used with learners at different levels of expertise and for different amounts of time. It is just a matter of adjusting what level of performance is expected. For example, the first author was working with some teachers who developed a problem related to the Oklahoma City

bombing. After the bombing, there was talk of tagging all fertilizer so if it was used in an attempted bombing, its source could be identified. A fifth grade teacher had her students determining how the tagging was done and also taking a position on the ethics of requiring that sort of tagging. Fifth graders! Of course this problem could be used with college students as well. We would simply expect different levels of performance. Similarly, in Army training problems, Soldiers at different ranks can be involved in similar problems but at different levels of complexity. Thus, for example, the same patrol problem or troop-leading problem could be used with Soldiers of different ranks with the time and performance expectations adapted as appropriate for the particular rank not unlike what already occurs in courses when Staff Sergeants and Sergeant First Class Soldiers have many of the same tasks as Lieutenants Some years back the MBA program at Ohio University (Stinson, 2004) used a problem simply stated as "Will Apple Computer survive?" When it was first used, students spent a month working on it full time (with many analyses required). However, as the curriculum evolved, this problem was used as a two-day problem to introduce the process. Again, the different amount of time allowed just leads to an adjustment of expectations.

The time allowed for the problem and the proficiency expected are important factors in the design of any problem. This is particularly true because the student plays a role in determining the outcomes achieved. In traditional instruction, time requirements can be specified reasonably precisely because the content related to the learning objective is "covered" by the instructor's presentation. However, in IBL, the student takes ownership of the problem. For this reason it is essential to pilot a course at least once before implementing it.

Deliverables/Progress Reports

The use of interim reports is one very important strategy for helping learners structure a complex task and for providing an opportunity to give learners feedback. A complex task might be broken into steps where each step requires an interim report. These are not make-work steps but rather steps that are natural to the process and similar to when a supervisor might step in for a review. In a business context, if we ask students to do an analysis of several international sites for the expansion of a company's production, there are several natural sub-products along the way, e.g., company analysis, competitive analysis, cultural analysis. In the Army, these requirements are similar to SITREPs that a commander expects on progress toward completing a mission. One example is the SALUTE (Size, Activity, Location, Unit, Time and Terrain, and Equipment) reports that a patrol sends back to the commander as the patrol collects data and provides more detail to the commander in the rear. Another example would be the platoon leader's responses to a company commander's OPORD. There is a natural first step of surveying the situation, identifying key variables, and formulating first thoughts on a response. This all goes into a Warning Order (WARNO) to the platoon. There is then a more detailed analysis validating or adjusting the strategy based on a deeper examination of the situation, the commander's intent, and doctrine. The final product is orders for the platoon.

Each one of the steps in the above examples provides a natural point for reporting on progress/current thinking. This in turn provides the opportunity for a check on student understanding and a discussion of key variables. These should not be long reports – brevity forces the learners to focus on what is most important. Also, in IBL exercises it can be problematic to define the progress report in terms of common report types (as in the examples above). All of the types have some protocol requirements and students place more focus on meeting the protocol rules and on how well any presentation looks than on the substance and personal usefulness of the report. It is important that the students focus on the problem and the help they can get in a progress report – and that they do not get caught up in the formatting and protocol of presenting the solution.

At times, a progress report can be used in a manner similar to or in conjunction with the deliverables. The deliverable is really an outcome for that stage of the work. In contrast the progress report focuses on how work is progressing. The class should know when they are expected to give informal updates on their work. Most teams will want to give a chronology of what they did – but this is not very useful. What should be required is a discussion of: where the team is struggling and why they are struggling; what their current thinking about the problem is; and what they are planning on next to resolve their struggles or test their current thinking. In essence the instructor wants to understand their critical thinking about the problem and wants them to use these meetings as a time to solicit advice. As they talk about their struggles, the instructors or classmates can offer suggestions of resources or other things to consider. And of course, everyone can ask questions.

Finally, if there are multiple teams, it is generally valuable to have the report by each team given to the whole class. This creates more of a class spirit and also gives each team a chance to see and learn from different perspectives on the problem. It can also create competitiveness in terms of trying to improve one team's solution to be better than another team's.

Coaching

This section addresses the role of the instructor as a coach. The next section discusses the role of the instructor in offering lectures and demonstrations. Coaching is very difficult because there is such a natural tendency to share expertise. But that sharing, done prematurely, simply removes the learner's responsibility for and ownership of sense making. There was an instance in one IBL based MBA program where a faculty member heard students struggling over a concept that was in his area of expertise. He decided that he knew how to explain it, so he invited them to meet with him for a lecture. Students are quick learners: they saw that they could get the faculty to lecture to them when they did not understand. So, they dropped their goals of problem solving in the content domain and adopted a new problem-solving goal: getting the faculty to explain. This whole process came to light because, after many years of successfully running the program, this particular year both students and faculty were complaining that little learning was occurring. An analysis identified this "premature sharing of expertise"

as the problem. Once those impromptu mini-lectures-on-demand were eliminated, learning began to progress satisfactorily.

When coaching, it is very important to always discuss from the learner's point of view. In some ways this is similar to the requirement Soldiers encounter when they must assess the Commander's intent. The Commander's specified tasks may be clear but the implied tasks, as complex and variable tasks, require additional skills such as those required in an IBL environment. In a similar way, the IBL coach must focus on the thinking of the students as they work through their interpretation and analysis of the problem. If it is a complex, ill-structured problem then the coach may not have thought of the approach the students are taking or the evidence/rationale for the approach. Coaching may involve engaging in discussion with the students but the role is to understand the students' perspectives and then ask questions that promote their critical thinking rather than directing or explaining. Questions such as, "What would happen if…, How does that relate to….., What is the evidence supporting that…., Is there criticism,…. What are the dangers in that approach – are there ways of addressing them….?" Of course these question frames are not asked so generally, but will be embedded in the particular domain context. Fosnot (1989) put the role of the coach best in describing the responsibility as being one of asking questions on the leading edge of the student's thinking.

Most of the questioning will occur during student updates and presentations. These provide a time for reflection, analysis, and feedback and thus care should be taken in scheduling them as discussed in the previous section. Besides asking questions, the instructor must remember to compliment critical thinking and analysis that is well done.

The instructor needs to be available while students are working. If students have questions it is always important to get their point of view before engaging in discussion. Don't let them come with their thinking unprepared. If they do, then simply let them know it is important that they have a point of view and analysis that can serve as the basis for discussion and send them away to prepare. The analysis need not be correct, it just forms the basis for the discussion. The exception to this is when students have questions for which they could not reasonably find an answer without going to the instructor. These will typically be questions about the requirements, permissions, access to resources and tools, or constraints of the situation. These questions should be answered; there should never be any game playing.

Lectures and Demonstrations

Lectures and demonstrations are a very important part of learning. Students need to have a deep and rich understanding of the concepts, strategies, and techniques and therefore there is a need to share instructors' expertise and make available the expertise of others. In a professional context, conferences, talks, and seminars are central to learning and to advancing thinking on a problem. It is just that the sharing of expertise must occur when the learners are ready. The value of the classroom lecture comes once the learner has completed an analysis and formulated a perspective. The learners have

engaged in sense making and know where their analysis still does not make sense. Even when they feel comfortable with their analysis, the lecture and related question and answer sessions provide the opportunity to check their thinking. In essence they are not a tabula rasa simply receiving wisdom (mastering the lecture), but rather they have a point of view and they use the instructor's expertise to evaluate, enrich and modify that point of view (see Sears; 2006, Schwarz, et.al. 2009; and Bransford & Schwartz,1998 for research indicating the importance of the sequencing of instruction and problem solving activities.)

If an issue is particularly complex, the lectures may be scheduled during the student's time working on the problem. That is, once they have engaged with the problem and explored the complexity, a lecture or demonstration can provide a basic orientation to the issue that they can use to continue building. A lecture may come very early in the process if there are complex aspects of the problem that are totally unfamiliar to the learners. However, it should be kept in mind that the problem and the learning requirements should be geared to the level of the students. Only in wrestling with the problem can they begin to form an analysis and be ready to receive additional guidance and clarification.

It is important that the lecture be informative and not directive. Therefore it is best to think of the lecture as addressing the issue or topic broadly and not addressing specifically the problem they are working on. The lecture should be viewed as a talk being given for a larger audience on a strategy, concept, or principle. It is not a talk that prescribes for them what they should do. Students can of course ask questions – but just as with any talk, time is limited. The section below on after action reviews discusses other uses of lectures.

Resources

Books, the Internet, other experts, doctrinal manuals, field manuals and tools (technology and otherwise) are all resources students may use. The designer must decide whether or not finding relevant resources is an important learning outcome. If it is not important, then all the needed resources are provided. If it is important, then of course finding resources is part of the task and part of the discussion of learning. It is interesting that many college students – even graduate students – will go to textbooks as a first source of information. However, they typically learn very quickly that the textbook information is too general and does not provide insights that help on particular problems. Hence they learn that primary, rather than secondary, sources are important in problem solving.

Assessment

In an IBL curriculum, time should be allotted to allow ample opportunity for both formal and informal assessment as well as the opportunity to provide feedback based on that assessment. Of course, it is important that clear expectations are set for the students so they know what they are being assessed on. Expectations need to be set for both the

specific content based learning outcomes and the cognitive (or higher order thinking) skills like leadership and team skills, critical thinking, confidence, initiative, etc.

During work on the problem, the instructor can assess incremental understanding of the learning outcomes as well as progress on the cognitive skills through observation of the team work and, in particular, in the interim progress reports or presentation of interim deliverables. During the progress report sessions in particular, the instructor can probe understanding and observe the thinking and leadership skills displayed by the students. It is important to ask good questions that promote thinking and to follow up on the students' thinking in successive progress reports or in the deliverable. The final presentation, where they present their position and the evidence or argument supporting their positions, provides a particularly valuable opportunity to probe understanding of the principles, procedures and concepts. This is the culmination of their work and thus it is the point where they should be able to respond to a wide range of questions and also where they should be clear as to where they are uncertain.

The end of the problem is the time for reflection and more formal assessment. An After Action Review (AAR) can ask the students to assess their own and their teammates' strengths and weaknesses in terms of both cognitive skills and learning outcomes. The AAR would also provide feedback on the problem, the instructor support, and the learning process as it related to work on the problem. The end of the problem is also the time for more formal assessment of the student mastery of the learning outcomes. The instructor can use whole class discussion, teams, or individual written assessments in asking the students to apply their knowledge and skills in new situations. These new situations may be entirely new problems or extensions of the problem they just worked on. In the latter case, the instructor would ask "what if" questions (CTGV, 1997), i.e., questions that ask how they would respond differently if some variable in the problem situation changed or if a particular outcome occurred. In using either what if questions or a new problem, it is important to probe in a way that will allow you to assess the students' understanding of the concepts, strategies, and principles.

Finally, the end of course activity should not just be about assessing students, it should also be a learning opportunity. The end of the course is a good time for more extended lectures. Those lectures should clarify topics and issues that were central to the problem, but like the assessments, they should also extend discussion to new contexts and new, related issues. It is after the students expended their energy studying the issues that they have a framework in which to organize and interpret the lecture and discussion material.

Developing an IBL Curriculum

Discussing the entire development process is beyond the scope and goals of this paper. However, what follows is a brief consideration of the analysis process that underlies the development of problems and thus forms the foundation for the instruction. This analysis is less time consuming and detailed than traditional front-end analysis in large part because we are bringing the work tasks or problems into the classroom to serve

as the basis for education and training. The basic goal in the front-end analysis is, in fact, to capture work situations that will engage the learner in the core concepts and strategies, in particular those where there are frequent errors.

Critical incident analysis (Flanagan, 1954; Nemeth, 2004) is one strategy for capturing those work situations. The critical incident analysis involves capturing key events in the workplace. Individuals are interviewed to identify specific instances of work tasks that went extremely well or where there were particular problems. The goal is to capture efficiencies of the workplace as well as problems that have to be dealt with. There is particular interest in identifying situations where there are frequent errors or serious errors. These are places to focus training.

These critical incidents are then discussed with the individual in order to capture the situation in detail as well as to capture the problem solving process involved, i.e., what decisions the individual faced, what option was chosen, and why it was chosen. While the interview focuses on understanding the cognitive processes or decision making related to the error, the goal is to also capture the richness of the situation including distractions, time pressures, competing demands, team coordination, etc that may be related to the problems. Once the key error events are captured and described, subject matter experts are used to validate the context, performance of the technical skills, and cognitive variables relevant to the errors. This analysis provides the basis for describing a problem situation and the learning outcomes that should be realized through the work on the problem in an IBL curriculum.

For the military, a similar strategy should be followed. This process involves working from a collection of battlefield scenarios that are naturally filled with a multitude of complex tasks and problems. Extensive analysis is not needed. Combat veterans and the Center for Army Lessons Learned (CALL) are a rich source for this analysis. Tactics, techniques and procedures (TTPs) and all the information necessary to solve the problem is built in as resources that students must understand during the in-class research (Raymer, 2006)

Traditional front-end analysis seeks to identify not only the learning outcomes but also all concepts, procedures, and skills that must be learned to achieve the outcome. These are the enabling objectives, i.e., they enable achieving the outcome. These enabling objectives as well as the outcomes are specified using a format that describes what must be done, under what conditions, and to what standard. Of course the process described above contrasts significantly to this traditional approach. In IBL, the problem itself defines the conditions under which they must perform and to what standard. The context is the scenario context itself – the rich data set that is part of the scenario. The standard is to be able to use that concept, procedure, or skill in order to provide a recommendation related to the problem that can be explained and defended and adapted if some aspects of the scenario change. That is, a deep understanding is expected. In a similar way, the enabling objectives themselves are simply a part of the problem scenario. The problem is designed so that key variables identified by workers and subject matter experts are important factors in the problem solving process. Thus the IBL

approach calls for rich development of problem scenarios and a consideration of key variables and learning outcomes related to those scenarios but it does not require the extensive list of all relevant variables that might be a part of a complex problem that individuals might face. These variables will evolve as the learner integrates them during the problem-solving process.

Discussion now returns to IBL and the final stages of the IBL analysis and development process. The analysis will identify a large number of scenarios and associated tasks, more than could possibly be used. There will also be a list of the key concepts, strategies, and procedures distributed across those problems that reflect the learning requirements. The goal is to take this database and compress and reduce it to a set of scenarios that captures the relevant concepts, procedures, and skills and that can be used within the allotted training time. To accomplish this, a matrix is developed showing the learning outcomes associated with each scenario. This process becomes a good tracking mechanism for cross-referencing learning outcomes against problems. Then key scenarios are identified that hold the potential to be used in training. Those scenarios are enriched and modified to include key learning outcomes and variables to the degree it is possible to do so without compromising the authenticity of the problem. That is, the scenario is modified to include variables that will set a context where the learner will need to consider additional concepts and procedures that are in the list of learning outcomes. As noted earlier, the goal of incorporating several outcomes in a scenario and enriching it based on related scenarios, is to focus learning activities on the smallest number of scenarios necessary to address the learning outcomes within the time available for learning. Of course, the final scenarios must maintain the complexity of the original scenarios as is reasonable in consideration of cost and danger.

This was by necessity a very brief overview of one strategy for conducting a front-end analysis and contrasting it to a more traditional approach. There is much more that could be said in elaborating this approach and in considering alternative IBL related analysis strategies.

Summary

The intellectual skills called for in the COE cannot be adequately filled by traditional instructional approaches. While the behavioral approach has been and continues to be extremely successful in training technical skills and the cognitive approach moves toward advancing thinking skills, it is the IBL approach that can maximize the acquisition of higher order thinking skills so needed in the COE.

As Dewey (1910) would describe it, IBL pushes learners to move from idle thoughts along a continuum in their problem-solving process to logical conclusions. When learners are placed in this type of learning environment they will develop the necessary thinking or inquiry skills of complex problem-solving, adaptability, initiative, critical and creative thinking and agility along with the skill sets of competence and confidence.

The IBL approach detailed in this paper is based upon the belief that all learning is an attempt on the part of the learner to make sense of the world – that instruction is most effective once the learner recognizes the need to learn and that learning is most effective when learners engage in an authentic problem that captures the complexities of the real world.

Misconceptions associated with this approach are numerous. Learners are not thrown into a discovery-only learning mode, they are not allowed to just derive any solution, instructors do provide direct instruction and finally, it is not just reserved for teaching of higher order thinking skills – it is appropriate to include training on technical skills within an IBL approach.

IBL is highly interactive and immersive, placing the learner into an environment of problem-solving, learner ownership and instructor-supported – not instructor directed -- instruction. For the instructor and training developer, learner outcomes associated with the key components of IBL, e.g., use of problems and resources, deliverables, coaching techniques, purposeful lectures and demonstrations, and assessment are provided.

It can only be hoped that further consideration for this approach will result in continued use and expansion of this method of instruction. Placing Soldiers in this type of learning environment will better prepare them for the complexities they will face in FSO.

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Appendix

This appendix provides an example of an international problem used in leadership training. This was used as a six-day problem and the curriculum schedule for those six days is also shown. The time for work on the problem could be expanded or contracted to reflect the different levels of expertise of the class. Mini-lectures in the schedule last 15 min at most and are general to the relevant concepts and issues (not problem specific). Workshops are less than an hour and are hands on. Note that there is considerable faculty guidance provided along with this schedule (Duffy, Stinson, Milter and Kirkley, 2008)

Problem

SEA LANES OF COMMUNICATION

Problem Charge
How does the United States guarantee continued free and open access to its Sea Lines of Communication (SLOC)? You are assigned to an Army Strategic Planning Team that is subordinate to a Joint Task Force conducting a strategic analysis of regional Sea Lines of Communications (SLOC). See attached map of the area.

There is considerable tension in the Pacific region (the South China Sea) and the Army Planning Team Commander expects that there will be some challenges to the current policies/agreements. Therefore he has formed this Strategic Planning Team to help him prepare an analysis of the national strategy for the key countries in the region as it pertains to the SLOC, how that strategy may change, and how the U.S. National Strategy compares to it. This analysis should include an analysis of negotiating points, "lines in the sand" that this country may have, and other critical considerations that would help in the negotiating process. You have been asked to serve on a team that will conduct the national strategy analysis for one of these countries.

Learning Outcomes
Analyze National Strategies
Implement Change
Create High Performance Teams
Manage Conflict
Evaluate Organizational Performance
Evaluate Organizational Requirements
Develop an Implementation Plan

Final Team Deliverables
1. Participation in a summit where each team will have 15 minutes to present the analysis of the national strategy of their country as it relates to the SLOC policies, where it is consistent and inconsistent with U.S. policy, and what are potential points of negotiating based on your analysis of the U.S. and your country's national strategies.

This will be a formal presentation. The presentation will be followed by 10 minutes of question and answer from members of the audience. Following the presentations there will be discussion of how the U.S. should respond in a summit with these countries. This will require you to think across the national strategies, to potentially reconsider your analysis of the U.S. national strategy.

2. A report not to exceed 3 pages that lays out your analysis of the U.S and your country's national strategies relative to relevant SLOCs, how the U.S. should respond to your country, and how your country's nationals strategy toward SLOC issues may change over the next three years and the implications of that for U.S. negotiation. Provide data and rationale to support your conclusions.

3. Prepare a country book providing background information on your country including information relevant to determining the country's national strategy and policies toward SLOC issues.

Schedule

Day 1: Problem Introduction and Team Assignments.

(1 hour) Whole class meeting. The class begins with the learning model being introduced. The model will be reviewed again after the students review the problem. Students are introduced to the problem, they are assigned to teams, and each team is assigned responsibility for analysis of a particular country.

After the problem is reviewed, they are assigned work that requires them to identify the issues they need to consider in conducting the analysis for the problem within their teams, e.g., what is important for them to know and to consider. The deliverable is the team's list of learning issues they need to address.

The second assignment requires each individual to review characteristics of high performance teams (HPT) and consider rules that will govern their team interactions and responsibilities. A set of resources are available online for the students. The deliverable is a proposed list of rules that will form the team charter.

The third assignment requires the teams to discuss the results of the individual research on high performance teams and rules for the team charter. The deliverable is an initial draft of the team charter and a 5 minute brief the next day on the charter explaining the rationale for the charter. These briefs are to the entire class. Faculty will review these charters and provide feedback.

Students are released to work on these assignments.

Day 2 Team. Preliminary Country Analysis

(1 hour) Whole class meeting. All students contribute to the identification of learning

issues. It is noted that this is a living document and can be expected to change as they analyze the problem

Assignments are given for the next day. The teams will begin to develop an analysis of their country's relevant characteristics and the preliminary analysis of their country's national strategy. The deliverable is a 5 minute brief on their initial findings and issues they face. A document no longer than 2 pages detailing this rationale for their conclusions on the national strategy is also required.

(15 minutes). Students are given a mini-lecture: Understanding the components of a national strategy.

(4 hours) Students are released to work in teams and individually.

(15 minutes) Students are given a mini-lecture: High performance teaming.

(2 hours) Students are released to work in teams.

(1 hour) Whole class meeting. Each team briefs their charter in 5 minutes and receives feedback from faculty and other teams. Students need to link items in their charter to assigned readings.

Day 3 Detailed U.S. Analysis

(1 hour) Whole class meeting. Teams present 5 min briefs of their country book data and their preliminary analysis of the national strategy followed by 5 minute Q&A from faculty and other teams.

Team assignment is to present a 5 min brief tomorrow morning on the U.S. national strategy and the implications for U.S. policy on SLOC, addressing the following issues in particular: What is the U.S.'s strategy relative to SLOCs in that area: Which SLOCs are most important? What forces might cause the strategy to change? What do you expect the strategy to be in 3 years? Provide data and rationale to support your conclusions.

(15 minutes) Mini-lecture on Strategic Vision and Action Plans

(4 hours) Team and individual Research

(1 hour) Workshop: Developing an Action Plan

(1 ½ hour) Team and Individual Research

(1 hour) Guest lecture on strategic visions and action plans. A lecture by a representative of another country outside the team's countries who discusses that country's strategic vision and its relation to an action plan.

Day 4. Detailed Country Analysis

(1 hour) Whole class meeting. Teams give 5 minute briefings on the U.S. national strategy and the implications for U.S. policy on SLOC. Also note any issues they are struggling with. Other teams and faculty provide feedback.

Students are assigned work to complete a detailed analysis of their country's national strategy and the policy implication for SLOC in that area. They will complete a report not to exceed 2 pages and prepare a 5-minute briefing for tomorrow morning.

(4 hours) Team and Individual Research

(1 Hour) Mid-Problem Team Reflection. In team rooms, the teams will focus on analyzing 1) how each team is functioning relative to its charter, 2) the critical characteristics of a high performance team (what has been most important to their success as a team, 3) adjustments in their charter as needed. The output is posted on the team's discussion forum along with a paragraph identifying what they defined as the critical characteristics of their team strategy.

(2 hours) Team and Individual Research

(1 hour) Workshop: Preparation for the Summit. This workshop will discuss some of the issues they should be prepared to discuss and clearly lay out the expectation for the summit.

Day 5: Summit Preparation

(1 hour) Whole class meeting. Teams provide 5 min briefs on their detailed analysis of their countries national strategy and the implications for SLOC. They will also raise any issues they are having in doing their analysis.

Teams will be reminded of the requirement for the final presentation, a 15 minute brief with slides on the national strategy of their country, how it relates to the U.S. national strategy and what the implications are for policy toward SLOC issues. They are to be prepared to do a practice presentation in the morning with the final Summit occurring after lunch.

(3 hours) Team and Individual Research

(1 hour) Workshop: Presentation Skills

(3 hours) Team and Individual Research

Day 6: Summit Day

(4 hours) Preparation and Practice in Team rooms for summit and Revisions as needed.

(3 hours) Summit

Day 7: Final Assessment

(1 hour) Teams review video of presentation and receive feedback from faculty and other team members in team room.

(1 hour) Students are tested to assess content and leadership learning.

(1 hour) In team rooms, teams will debrief on member and team performance based on team charter.

(1 hour) Teams will conduct AAR assessing effectiveness of their problem, learning and blocks to learning